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CONTENTS

THE TEACHING OF SCIENCE[1]

THE prime claim of science to a place in the school curriculum is based upon the intellectual value of the subject matter and its application to life. This conception of education through science as the best preparation for complete living was Herbert Spencer's contribution to educational theory; and to its influence the introduction of science into the school is largely due. Spencer's doctrine was in accord with the principles of Pestalozzi as to the sequence in which facts and ideas should be presented and be related to stages of development, in order to be effective in creating or fostering natural interests in the mind of the child. Scientific instruction implies, therefore, not alone knowledge that is best for use in life, but knowledge adapted to the normal course of mental development. Both substance and method should be judged by the criterion of what is of greatest immediate worth or nearest to the pupil's interest at the moment. When this standard of psychological suitability is applied to the school science courses now usually followed, it must be confessed that they rarely reach it, many topics and much material being remote from the pupil's natural interests and needs.

The truth is that in the design of science courses for schools "trial-and-error" methods have been followed. In the absence of accurate knowledge these are the only possible methods of construction, but sufficient is now known of child psychology to produce a scheme of scientific instruction which represents not merely the views of advocates of particular subjects, but is biologically sound because it is in accord with the principles of mental growth, and, therefore, with those of

[1] From the address of the president of the Section of Educational Science, British Association for the Advancement of Science, Hull, September, 1922.

educational science. When instruction in science was first introduced into schools its character was determined by insight and conviction rather than by mental needs or interests; so later, when practical work came to be regarded as an essential part of such instruction, its nature and scope represented what certain authorities believed pupils should do, instead of what they were capable of doing with intelligence and purpose. Practical chemistry became drill in the test-tubing operations of qualitative analysis, and the result was so unsatisfactory from the points of view of both science and education that when Professor Armstrong put forward a scheme of instruction devised by him, in which intelligent experimentation took the place of routine exercises, acknowledgment of its superior educational value could not be withheld, and for thirty years its principles have influenced the greater part of the science teaching in our schools.

In its aims the "heuristic" methods of studying science energetically advocated by Professor Armstrong were much the same as those associated with the names of other educational reformers. Education in every age tends to a condition of scholasticism, and practical science teaching is no exception to this general rule, its trend being towards ritual, after which a revolt follows in the natural order of events. Comenius, with his insistence upon sense perception as the foundation of early training—"Leave nothing," he said, "until it has been impressed by means of the ear, the eye, the tongue, the hand." John Dury among the Commonwealth writers who urged that pupils should be guided to observe all things and reflect upon them; Locke, with his use of sciences not to bring about "a variety and stock of knowledge, but a variety and freedom of thinking"; and Rousseau who would "measure, reason, weigh, compare," not in order to teach particular sciences, but to develop methods of learning them—all these were in different degrees apostles of the same gospel of education according to Nature, and the development of a scientific habit of mind as the intention of instruction. What Rousseau persistently urged in this direction was clearly formulated by Spencer in the words, "Children should be led to make their own investigations, and to draw their own inferences. They should be *told* as little as possible, and induced to *discover* as much as possible"—principles which cover all that is implied in what has since been termed "heuristic" teaching.

Professor Armstrong's particular contribution to educational science consisted in the production of detailed schemes of work in which these principles were put into practice. Ideas are relatively cheap, and it needs a master mind to make a coherent story or useful structure from them. This was done in the courses in chemistry outlined in reports presented to the British Association in 1889 and 1890, and the effect was a complete change in the methods of teaching that subject. "The great mistake," said Professor Armstrong, "that has been made hitherto is that of attempting to teach the elements of this or that special branch of science; what we should seek to do is to impart the elements of scientific method and inculcate wisdom, so choosing the material studied as to develop an intelligent appreciation of what is going on in the world." One feature of heuristic instruction emphasized by its modern advocate, but often neglected, is that which it presents to the teaching of English. Accounts of experiments had to be written out in literary form describing the purpose of the inquiry and the bearing of the results upon the questions raised, and wide reading of original works was encouraged. A few years ago English composition was regarded as a thing apart from written work in science, but this should not be so, and most teachers would now agree with the view expressed by Sir J. J. Thomson's committee on the position of natural science in the educational system of Great Britain that "All through the science course the greatest care should be taken to insist on the accurate use of the English language, and the longer the time given to science the greater becomes the responsibility of the teacher in this matter. . . . The conventional jargon of laboratories, which is far too common in much that is written on pure and applied science, is quite out of place in schools."

When heuristic methods are followed in the spirit in which they were conceived, namely,

that of arousing interest in common occurrences, and leading pupils to follow clues as to their cause, as a detective unravels a mystery, there is no doubt as to their success. No one supposes that pupils must find out everything for themselves by practical inquiry, but they can be trained to bring intelligent thought upon simple facts and phenomena, and to devise experiments to test their own explanations of what they themselves have observed. It is impossible, however, to be true to heuristic methods in the teaching of science and at the same time pay addresses to a syllabus. A single question raised by a pupil may take a term or a year to arrive at a reasonable answer, and the time may be well spent in forming habits of independent thinking about evidence obtained at first-hand, but the work cannot also embrace a prescribed range of scientific topics. Yet under existing conditions, in which examinations are used to test attainments, this double duty has to be attempted by even the most enlightened and progressive teachers of school science. There can, indeed, be no profitable training in research methods in school laboratories under the shadow of examination syllabuses. Where there is freedom from such restraint, and individual pupils can be permitted to proceed at their own speeds in inquiries initiated on their own motives, success is assured, but in few schools are such conditions practicable; so that, in the main, strict adherence to the heuristic method is a policy of perfection which may be aimed at but is rarely reached.

A necessary condition of the research method of teaching science is that the pupils themselves must consider the problems presented to them as worth solving, and not merely laboratory exercises. Moreover, the inquiries undertaken must be such as can lead to clear conclusions when the experimental work is accurately performed. It may be doubted whether the rusting of iron or the study of germination of beans and the growth of seedlings fulfils the first of these conditions, and the common adoption of these subjects of inquiry is due to custom and convenience rather than to recognition of what most pupils consider to be worth their efforts. It needed a Priestley and a Lavoisier to proceed from the rusting of iron to the composition of air and water, and even such an acute investigator as Galileo, though well aware that air has weight, did not understand how this fact explained the working of the common suction pump. If research methods are to be followed faithfully, and what pupils want to discover about natural facts and phenomena is to determine what they do, then teachers must be prepared to guide them in scores of inquiries both in and out of the laboratory. Under the exigencies of school work it is impracticable to contemplate such procedure, and all that can be usefully attempted is to lead pupils to read the book of Nature and to understand how difficult it is to obtain a precise answer to what may seem the simplest question.

The mission of school science should not, indeed, be only to provide training in scientific method—valuable as this is to every one. Such training does cultivate painstaking and observant habits, and encourages independent and intelligent reasoning, but it can not be held in these days that any one subject may be used for the general nourishment of faculties which are thereby rendered more capable of assimilating other subjects. Modern psychology, as well as everyday experience, has disposed of this belief. If the doctrine of transfer of power were psychologically sound, then as good a case could be made out for the classical languages as for science, because they also may be taught so as to develop the power of solving problems and of acquiring knowledge at the same time. When, therefore, advocates of particular courses of instruction state that they do not pretend to teach science, but are concerned solely with method, they show unwise indifference to what is known about educational values. Locke's disciplinary theory—that the process of learning trains faculties for use in any fields, and that the nature of the subject is of little consequence—can no longer be entertained. It has now to be acknowledged that information obtained in the years of school life is as important as the process of obtaining it; that, in other words, subject matter as well as the doctrine of formal discipline must be taken into consideration in designing courses of scientific instruction which will conform to the best educational principles.

So long ago as 1867 the distinction between subject and method was clearly stated by a Committee of the British Association, which included among its members Professor Huxley, Professor Tyndall and Canon Wilson. It was pointed out that general literary acquaintance with scientific things in actual life and knowledge relating to common facts and phenomena of nature were as desirable as the habits of mind aimed at in scientific training through "experimental physics, elementary chemistry and botany." The subjects which the committee recommended for scientific information, as distinguished from training, comprehended "a general description of the solar system; of the form and physical geography of the earth, and such natural phenomena as tides, currents, winds and the causes that influence climate; of the broad facts of geology; of elementary natural history with especial reference to the useful plants and animals; and of the rudiments of physiology." If we add to this outline a few suitable topics illustrating applications of science to everyday life, we have a course of instruction much more suitable for all pupils as a part of their general education than what is now commonly followed in secondary schools. It will be a course which will excite wonder and stimulate the imagination, will promote active interest in the beauty and order of nature, and the extension of the kingdom of man, and provide guidance in the laws of healthy life.

The purpose of this kind of instruction is, of course, altogether different from that of practical experiment in the laboratory. One of the functions is to provide pupils with a knowledge of the nature of everyday phenomena and applications of science, and of the meaning of scientific words in common use. Instead of aiming at creating appreciation of scientific method by an intensive study of a narrow field, a wide range of subjects should be presented in order to give extensive views which can not possibly be obtained through experimental work alone. The object is indeed almost as much literary as scientific, and the early lessons necessary for its attainment ought to be within the capacity of every qualified teacher of English. Without acquaintance with the common vocabulary of natural science a large and increasing body of current literature is unintelligible, and there are classical scientific works which are just as worthy of study in both style and substance as many of the English texts prescribed for use in schools. We all now accept the view that science students should be taught to express themselves in good English, but little is heard of the equal necessity for students of the English language to possess even an elementary knowledge of the ideas and terminology of everyday science, which are vital elements in the modern world, and which it is the business of literature to present and interpret.

So much has been, and can be, said in favor of broad courses of general informative science in addition to laboratory instruction and lessons which follow closely upon it, that the rarity of such courses in our secondary schools is a little surprising at first sight. Their absence seems to be due to several reasons. In the first place, the teachers themselves are specialists in physics, chemistry, biology or some other department of science, and they occupy their own territory in school as definitely as Mr. Eliot Howard has shown to be the behavior-routine of birds in woods and fields. You may, therefore, have a teacher of physics who has taken an honors degree and yet knows less of plant or animal life than a child in an elementary school where nature study is wisely taught; and, on the other hand, there are teachers of natural history altogether unacquainted with the influence of physical and chemical conditions upon the observations they describe or the conclusions they reach. Natural science as a single subject no longer exists either in school or university, and with its division and sub-division has come a corresponding limitation of interest. No man can now be considered as having received a liberal education if he knows nothing of the scientific thought around him, but it is equally true that no man of science is scientifically educated unless his range of intellectual vision embraces the outstanding facts and principles of all the main branches of natural knowledge. It cannot reasonably be suggested that this general knowledge of science should be acquired by all

if teachers of science themselves do not possess it. During the past thirty years or so there has been far too much boundary-marking of science teaching in school on account of the specialized qualifications of the teachers. What is wanted is less attention to the conventional division of science into separate compartments designed by examining bodies, and more to the whole field of nature and the scientific activities by which man has transformed the world; and no teacher of school science should be unwilling or unqualified to impart such instruction to his pupils.

Where such teachers do exist, however, they are compelled by the exigencies of examinations to conform to syllabuses of which the boundary lines are no more natural than those which mark political divisions of countries on a map of the world. All that can be said in favor of the delimination of territory is that it is convenient; the examiner knows what the scope of his questions may be, and teachers the limits of the field they are expected to survey with their pupils. While, therefore, it may be believed that a general course of science is best suited to the needs of pupils up to the age of about sixteen years, examining authorities recognize no course of this character, and very few schools include it in the curriculum. Expressed in other words, the proximate or ultimate end of the instruction is not education but examination, not the revealing of wide prospects because of the stimulus and interest to be derived from them, but the study of an arbitrary group of topics prescribed because knowledge of them can be readily tested. It may be urged that this is the only practicable plan to adopt if a science course is to have a defined shape, and not, like much that passes for nature study, merely odds and ends about nature, without articulation or purpose. Acceptance of this view, however, carries with it the acknowledgment that expediency rather than principle has to determine the scope and character of school science, which is equivalent to saying that science has no secure place in educational theory. I prefer to believe that a school course of general science can be constructed which is largely informative and at the same time truly educational, but it must provide what is best adapted to enlarge the outlook and develop the capacity of the minds which receive it, and not be determined by the facilities it offers for examinational tests.

A third reason for the relative absence of general scientific education in schools is the demands which the teaching might make upon apparatus and equipment. Simple quantitative work in physics, chemistry or botany can be done in the laboratory with little apparatus, and a single experiment may occupy a pupil for several teaching periods. To attempt to provide the means by which all pupils can observe for themselves a wide range of unrelated facts and phenomena belonging to the biological as well as to the physical sciences is obviously impracticable, and would be educationally ineffective. Experiments carried out in the laboratory should chiefly serve to train and test capacity of attacking problems and arriving at precise results just as definitely as do exercises in mathematical teaching. But knowledge by itself, whether of quantitative or qualitative character, is not sufficient, and it becomes power only when it is expressed or used. Every observation or experiment carries with it, therefore, the duty of recording it clearly and fully in words or computations, or both, and if this is faithfully done laboratory work of any kind may be made an aid to English composition as well as an incentive to independent inquiry and intelligent thought.

It is very difficult, however, to devise a laboratory course of general science which shall be both coherent and educative; shall be, in other words, both extensive in scope and intensive in method. I doubt, indeed, whether any practical course can perform this double function successfully. Probably the best working plan is to keep the descriptive lessons and the experimental problems separate, using demonstrations in the class-room as illustrations, and leaving the laboratory work to itself as a means of training in scientific method or of giving a practical acquaintance with a selected series of facts and principles. The main thing to avoid is the limitation of the science teaching to what can be done practically; for no general survey is possible under such conditions. Even if two thirds of the time available for scientific instruction be devoted to laboratory experiment and questions provoked by it, the

remaining third should be used to reveal the wonder and the power and the poetry of scientific work and thought; to be an introduction to the rainbow-tinted world of nature as well as provide notes and a vocabulary which will make classical and contemporary scientific literature intelligible. If there must be a test of attention and understanding in connection with such descriptive lessons, because of the spirit of indifference inherent in many minds—young as well as old—let it be such as will show comprehension of the main facts and ideas presented and knowledge of the meaning of the words and terms used. In this way descriptive lessons may be used to provide material for work and active thought, and light dalliance with scientific subjects avoided.

It may be urged that no knowledge of this kind has any scientific reality unless it is derived from first-hand experience, and this is no doubt right in one sense; yet it is well to remember that science, like art, is long while school life is short, and that though practical familiarity with scientific things must be limited, much pleasure and profit can be derived from becoming acquainted with what others have seen or thought. It is true that we learn from personal experience, but a wise man learns also from the experience of others, and one purpose of a descriptive science course should be to cultivate this capacity of understanding what others have described. As in art, or in music, or in literature, the intention of school teaching should be mainly to promote appreciation of what is best in them rather than to train artists, musicians or men of letters, so in science the most appropriate instruction for a class as an entity must be that which expands the vision and creates a spirit of reverence for nature and the power of man, and not that which aims solely at training scientific investigators. It should conform with Kant's view that the ultimate ideal of education is nothing less than the perfection of human nature, and not merely a goal to be obtained by the select few.

The sum and substance of this address is a plea for the expansion of scientific instruction in this humanizing spirit, for widening the gateway into the land of promise where the destinies of the human race are shaped. It is the privilege of a president to be to some extent pontifical—to express opinions which in other circumstances would demand qualification—and to leave others to determine how far the doctrines pronounced can be put into practice in daily life. I do not, therefore, attempt to suggest the outlines of courses of science teaching for pupils of different ages, or for schools of different types; this has been done already in a number of books and reports, among the latter being the report of Sir J. J. Thomson's committee on the position of natural science, the report of the British Association committee on science teaching in secondary schools, Mr. O. H. Latter's report to the Board of Education on science teaching in public schools, the "science for all" report and syllabus issued by the Science Masters' Association, a Board of Education report on "Some Experiments in the Teaching of Science and Handwork in Certain Elementary Schools in London," and one prepared for the board by Mr. J. Dover Wilson on "Humanism in the Continuation School." What has been said in this address as to the need for extending the outlook of customary scientific instruction beyond the narrow range of manual exercises, manipulative dexterity, experimental ritual or incipient research, can be both amplified and justified from these reports. I want science not only to be a means of stimulating real and careful thinking through doing things, but also a means of creating interest and enlarging the working vocabulary of the pupils and thus truly increasing their range of intelligence. So may scientific instruction be made a power and an inspiration by giving, in the words of the Book of Wisdom (vii: 16-20):

> an unerring knowledge of the things that are,
> To know the constitution of the world and the operation of the elements;
> The beginning and end and middle of times,
> The alternations of the solstices and the changes of seasons,
> The circuits of years and the positions of stars;
> The nature of living creatures and the raging of wild beasts,
> The violences of wind and the thoughts of men,
> The diversities of plants and the virtues of roots.

When school science has this outlook it will lie closer to the human heart than it does at present, and a common bond of sympathy will be formed between all who are guiding the growth of young minds for both beauty and strength. So will the community of educational aims be established and the place of science in modern life be understood by a generation which will be entrusted with the task of making a new heaven and a new earth. If these trustees for the future learn to know science in spirit as well as in truth we may look forward with happy confidence to the social structure they will build, in which knowledge will be the bedrock of springs of action and wisdom will make man the worthy monarch of the world.

Richard Gregory

FROG AND TOAD TADPOLES AS SOURCES OF INTESTINAL PROTOZOA FOR TEACHING PURPOSES

Many teachers of protozoology and invertebrate zoology use frogs for the purpose of obtaining intestinal protozoa for class use, but it does not seem to be generally known that the tadpoles of frogs and toads are even more valuable than the adults as sources of material. Unfortunately tadpoles are most abundant late in the spring and in early summer when classes are usually not in session, but two species of frogs that are more or less common throughout the United States pass two or more seasons in the tadpole stage and hence are available in the autumn and, in the southern part of the country, at any time of the year; these are the green frog, *Rana clamitans*, and the bullfrog, *R. catesbiana*. The former is common throughout eastern North America, inhabiting swamps and large and small ponds; the latter has a similar distribution but is limited to swamps and the larger and deeper ponds. Tadpoles should be looked for in these habitats. The identification of these, so far as their use as material for intestinal protozoa is concerned, is of little importance, but it may be stated here that the tadpoles of the two species are very similar and difficult to distinguish from each other. Full descriptions of them are given by Wright (1914). A breeding place once found will serve as a source of supply year after year. Sample tadpoles should be collected some time before the class meets so as to determine the incidence of infection and numbers present of the various species of protozoa, since this varies from year to year. The specimens for class use may be collected several days before they are needed but should not be kept in the laboratory for more than a week or two since they tend to lose their infections under laboratory conditions. The writer has found dishes about ten inches in diameter and three inches deep containing a quart of tap water to be suitable for about twenty tadpoles each. The dishes should not be covered with glass plates, but the water should be changed every day or two. Tadpoles may be killed very quickly, as adult frogs usually are, by destroying the brain and spinal cord with a heavy needle. The ventral body wall can then be opened from the anterior to the posterior end. The intestine is coiled within the body cavity, being several hundred millimeters in length. The rectum, or posterior portion of the alimentary tract, is tightly coiled and is separated from the intestine by a constriction. The different species of intestinal protozoa are rather definitely distributed within the intestine and rectum. The anterior portion of the intestine is inhabited by a flagellate, *Giardia agilis;* in various parts of the intestine and rectum *Endamœba ranarum* may be found; the rectum is the principal habitat of two genera of ciliates, *Opalina* and *Nyctotherus,* of two genera of flagellates, *Trichomonas* and *Hexamitus,* and of several green flagellates resembling members of the genera *Euglena* and *Phacus*. To study any of these species in the living condition, the part of the digestive tract containing them should be teased out in a drop of 0.7 per cent. salt solution and covered with a cover glass. Any of the species mentioned can be found with low magnification, such as obtained with a 16 mm. objective and a number 5 ocular. To study the details of most of these protozoa, however, the Schaudinn iron-hæmotoxylin method is necessary. This in brief is as follows: Spread the intestinal or rectal contents in a thin layer over about one half the area of

a 3x1 glass slide. Before this has a chance to dry drop it face downward into a dish containing Schaudinn's fixing solution. This is made up of a saturated solution of mercuric chloride in distilled water, 200 c.c.; 95 per cent. alcohol, 100 c.c.; and glacial acetic acid, 15 c.c. Leave in this solution for about ten minutes. The slide should then be treated by the well-known iron-hæmotoxylin method (70 per cent. alcohol plus iodin, 30 minutes to 24 hours; water, a few minutes; four per cent. aqueous solution of iron alum, 1 to 4 hours; rinse in water; 0.5 per cent. aqueous solution of hæmotoxylin, 4 to 24 hours; rinse in water; differentiate in two per cent. iron alum; wash thoroughly; dehydrate; mount).

Giardia agilis inhabits the anterior portion of the intestine. First observed by Kunstler in 1882, it has recently been studied in detail (Hegner, 1922). When alive it looks like a minute, slender tadpole and undergoes extremely rapid wriggling movements which no doubt suggested its specific name. When fixed and stained as suggested above it exhibits bilateral symmetry, with two nuclei, four pairs of flagella with intracytoplasmic portions, a pair of axostyles, and one or several parabasal bodies. Another species of this genus, *Giardia lamblia,* occurs in about 12 per cent. of human beings (Hegner and Payne, 1921). This species, which has been carefully studied and described by Simon (1921, 1922), is considered by some to be responsible for serious intestinal disturbances, but may be present in apparently healthy persons.

Trichomonas augusta is confined principally to the rectum, although it occurs occasionally in the intestine of the tadpole. This flagellate may be recognized by its jerky movement. When the living animal is examined with high magnification its active undulating membrane, along the outer edge of which is fastened a flagellum, can be seen; waves of motion start at the anterior end and pass posteriorly to the end of the body. Such an undulating membrane is characteristic of certain parasitic protozoa. The pointed extension of the rod-like axostyle may also be seen protruding from the posterior end. When fixed and stained a single nucleus, three anterior flagella, the undulating membrane, axostyle and mouth are clearly revealed. A species of *Trichomonas, T. hominis,* that occurs in man is similar in appearance to that in the tadpole but does not stain well and hence its structure is difficult to determine. Trichomonads that have been recorded from man are *T. hominis,* in the intestine; *T. vaginalis,* in the vagina; and *T. buccalis,* in the mouth. The intestinal form has been found in about three per cent. of the human beings examined.

Hexamitus intestinalis is a very minute species with two nuclei, and four anterior and two posterior flagella. It is an active swimmer and moves rapidly across the microscopic field. It differs from *Trichomonas* in the absence of a mouth and probably takes in its food through the surface of the body. No species of this genus are known from man.

Nyctotherus cordiformis is a very large ciliate that is often found in the rectum of tadpoles. It appears to be a scavenger and resembles *Paramecium* in structure and in its primary life processes. A species of this genus, *N. faba,* has been recorded from man.

Opalina ranarum is also a large ciliate that is a frequent inhabitant of the rectum of tadpoles. This and other species of *Opalina* that also may be encountered in this habitat are especially interesting because of their polynuclear condition and absence of an oral aperture, food being absorbed through the body wall. The variations in nuclear number and structure in various members of the Opalinidæ are of particular interest (Metcalf, 1914). The value of these protozoa with respect to problems of geographical distribution has been emphasized by Metcalf (in press).

Balantidium entozoon is an inhabitant of the rectum of certain frogs. It has not been found by the writer in tadpoles, but probably occurs in them in certain localities. Its mouth is situated near the anterior end instead of forming a large conspicuous crescent near the center of the body as in *Nyctotherus.* A human species of *Balantidium, B. coli,* although not very common, is sometimes very pathogenic, causing intestinal ulcers and frequently bringing about the death of the host.

Endamœba ranarum is a species that is often abundant in tadpoles. It is of particular in-

terest because of its close resemblance to *E. histolytica,* which causes dysentery in man, and has been found in about nine per cent. of all human beings examined.

Recently the writer has discovered Euglena-like flagellates in the rectum and intestine of tadpoles. One species has many of the characteristics of free living Euglenæ including green chromatophores, a reservoir and a red stigma. This species possesses three flagella. Another species resembles *Euglena spirogyra* and a third species is similar to *Phacus pleuronectes.*

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R. W. HEGNER

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SCIENTIFIC EVENTS

ALEXANDER SMITH

THE New York Section of the American Chemical Society having appointed a committee, consisting of Professors Thomas B. Freas, Ralph H. McKee and James Kendall, chairman, to draw up resolutions in memory of the late Professor Smith, the following resolutions were prepared and approved by the section on October 6:

Whereas, By the death of Alexander Smith at Edinburgh on September 8, 1922, the American Chemical Society has been deprived of a past president and the New York Section has lost one of its most highly esteemed members:

And whereas, Although the work of Alexander Smith as a teacher, as an administrator, and as an investigator in chemistry survives as an enduring monument to his name, yet it is none the less our privilege to put on record in the minutes of the section our sincere appreciation of his outstanding scientific genius and of his rare personal integrity and charm;

Be it therefore resolved, That the New York Section of the American Chemical Society express its profound regret at the passing of this distinguished leader in chemistry, who by his labors has added luster to science both in the land of his birth and in the land of his adoption;

And be it further resolved, That copies of this memorandum be forwarded to his widow and to his sister, with the respectful sympathy of the section.

THE TOTAL SOLAR ECLIPSE OF SEPTEMBER 21

DR. A. C. D. CROMMELIN, writing in *Nature,* says that the failure of the Christmas Island eclipse expedition is a great astronomical disappointment. Messrs. Jones and Melotte have devoted ten months or more to it, and hoped to secure useful photometric results for connectng the northern and southern stellar magnitude scales in addition to the eclipse work. The climate, however, proved unexpectedly unfavorable, and practically nothing could be done.

On the other hand, the conditions appear to have been ideal right across Australia, and enthusiastic reports have come from Wollal (West Coast), Cordillo Downs (center) and Goondiwindi and Stanthorpe (Queensland). The Einstein problem was studied at Wollal by the Lick Observatory party under Professor Campbell, and that from Toronto under Professor Chant. Mr. Evershed also finally selected this station in preference to the Maldives, and is believed to have undertaken the same investigation, in addition, doubtless, to spectroscopic work. Professor Dodwell, the government as-

tronomer at Adelaide, had the use at Cordillo Downs of a tower telescope lent by the Lick Observatory for the Einstein problem; the New South Wales astronomers were in Queensland and did some spectroscopic work; they intended also to make Einstein investigations, but the telegrams do not allude to these.

It is well to point out that the test of the Einstein theory does not depend wholly on the results of this eclipse. The plates secured in the 1919 eclipse at Principe and Sobral settled definitely that at least the half-shift was present, while the two cameras with the best definition gave values very close to the Einstein value. Further, the star-field in that eclipse was the best along the whole extent of the ecliptic, the stars in the present eclipse being much fainter. There are, however, two circumstances that should add weight to this eclipse: (1) that some of the observers were pointing directly on the stars, avoiding the use of a cœlostat or other mirror; (2) that the plan was being tried of photographing another star-field *during totality,* thus obtaining an independent scale-value for the plates, which gives a much larger coefficient to the Einstein displacement in the equations of condition.

Probably weeks or months must elapse before the Einstein results are to hand. The corona is said to have had four long streamers, one extending to three solar diameters, which is more than the average, though by no means a record. Professor Chant reports that the shadow bands were photographed. Professor Kerr Grant, of Adelaide University, made measures at Cordillo by the photo-electric cell of the relative brightness of the sun and the corona. The results, with this very sensitive instrument, should be more trustworthy than previous determinations.

The next two total eclipses (1923, September, and 1925, January) are visible in the United States; 1926, January, in Sumatra, etc., and 1921 in England and Norway.

THE FIJI-NEW ZEALAND EXPEDITION OF THE STATE UNIVERSITY OF IOWA

The Fiji-New Zealand party from the University of Iowa arrived in San Francisco on September 4 by the Pacific steamer *Tahiti.* This expedition was organized by Professor C. C. Nutting, head of the department of zoology of the University of Iowa, and included the following additional members from the faculty of that institution: Professor Robert B. Wylie, botanist; Professor A. O. Thomas, geologist; Dr. Dayton Stoner, entomologist, and Mr. Waldo Glock, assistant in geology. Mrs. Dayton Stoner, wife of Professor Stoner, accompanied her husband and assisted in the work with insects. The party left Vancouver on the *Niagara* on May 19, and after spending five weeks in Fiji went on to New Zealand for a like period, working mainly in North Island.

The expedition was greatly aided by the officials of these islands, with whom Professor Nutting as director had made preliminary arrangements by correspondence. Considerable collections were secured by each member of the party in his own field, including both illustrative and research material. Several hundred negatives were secured which will be used as a basis of illustration in lectures and publications. The Dominion Museums, both at Auckland and Wellington, New Zealand, were especially helpful; they extended to the party use of their buildings as temporary laboratories, offered helpful cooperation at all times, and contributed many valuable specimens to the University of Iowa Museum. Their gifts included four living and two preserved Sphenodons.

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

The eighteenth annual New England Intercollegiate Geological Excursion was held in the vicinity of Springfield and Northampton, Massachusetts, on the sixth and seventh of October. Professor J. W. Goldthwait, of Dartmouth College, and Dr. Ernst Antevs, of the University of Stockholm, were the leaders. Dr. Antevs, who has continued the work of Baron de Geer since the latter's return to Sweden, demonstrated the field methods which have led him to important conclusions concerning the glacial history of New England. His chief conclusions are (1) that the Wisconsin ice-sheet retreated from Hartford, Connecticut, to the northern border of Vermont in a period of approximately 4,000 years; (2) that this time

interval can not be correlated definitely with the period of 13,500 years which, according to de Geer, is the approximate number of years ago at which the last ice-sheet started to retreat across southern Sweden; (3) that an isostatic bulge made a freshwater lake of Long Island Sound during the last glacial period; and (4) that the axis of post-glacial tilting lies in the vicinity of Hartford, the dam holding back the lake in Long Island Sound between Fisher's Island and Long Island having been submerged approximately 200 feet in post-glacial time, or tilted southward from New Haven approximately eight feet to the mile.

Sixteen New England colleges and institutions, as well as the United States Geological Survey, were represented on the excursion. The list of institutions is Amherst (1), Brown (2), Clark (2), Colby (1), Dartmouth (1), Hartford High (2), Harvard (2), Massachusetts Agricultural (1), Mount Holyoke (3), Smith (6), Springfield Schools (1), Trinity (1), University of Stockholm (1), University of Vermont (1), United States Geological Survey (1), Wesleyan (2), Williams (5), Yale (7), unattached (1). The total attendance was, therefore, 41.

LECTURES OF THE LOWELL INSTITUTE

AMONG seven courses of Lowell lectures to be given during the present season are the following:

A course of eight lectures by Harlow Shapley, Ph.D., Paine professor of astronomy at Harvard Unversity and director of the Harvard College Observatory, on "The Content and Structure of the Sidereal Universe." 1. The Problems of Modern Astronomy. 2. Space, Time and Starlight. 3. Stars and Atoms. 4. Stellar Variation and Evolution. 5. Measuring the Milky Way. 6. Nebulæ and Island Universes. 7. Origin of the Earth. 8. Life and the Physical Universe. Tuesdays and Fridays at 8 o'clock in the evening, beginnng Tuesday, October 24.

A course of eight lectures by Edwin Grant Conklin, Ph.D., Sc.D., professor of biology in Princeton University, on "The Revolt against Darwinism." 1. Evolution, Historical and Experimental. 2. The Materials of Evolution. 3. The Rôle of Selection in Species Formation. 4. The Cellular Basis of Heredity. 5. The Cellular Basis of Development and Evolution. 6. Directions and Rates of Evolution. 7. The Mechanism of Adaptation. 8. Mechanism and Teleology. Wednesdays and Mondays at 8 o'clock in the evening, beginning on Wednesday, November 22, and omitting Wednesday, November 29.

A course of six lectures by A. Hamilton Rice, A.M., M.D., on "Journeys and Explorations in Tropical South America." 1. Physical Outlines of South America. Desiderata in Exploration. Some Notes on South American Hydrography. 2. Historical. Quito to the Amazons by the River Napo, the Route of Pizarro and Orellana. Caracas to Bogota by the Route of Bolivar and the Foreign Legion across the Venezuelan Lianos and the Colombian Andes. 3. Bogota and Exploration of the River Calaro-Uaupes, the Great West Affluent of the Rio Negro. 4. Further Explorations of the N. W. Amazons Valley, including the Sources of the Caqueta and the Rivers Inirida and Icana. 5. The Great Rio Negro (Amazons). 6. The Casiquiare Canal and the Upper Orinoco. Fridays and Tuesdays at five o'clock in the afternoon, beginning on Friday, December 1.

A course of six lectures by W. J. V. Osterhout, Ph.D., professor of botany, Harvard University, on "The Nature of Life and Death." 1. Growth. 2. Reproduction and Motion. 3. Irritability. 4. Constructive Metabolism. 5. Destructive Metabolism. 6. Permeability. Thursdays and Mondays at 8 o'clock in the evening, beginning on Thursday, January 4.

INSTALLATION OF THE CHANCELLOR OF THE UNIVERSITY OF BUFFALO

DR. SAMUEL PAUL CAPEN, director of the American Council on Education since its organization in 1919, resigns this month to become chancellor of the University of Buffalo. This institution more than a year ago conducted an endowment fund campaign in which 26,000 citizens contributed more than $5,000,000. Dr.

Capen, as the new head of the institution, will have charge of developing the greater university. Its enrollment this fall totals 1,670 in the colleges of medicine, law, pharmacy, chemistry, arts and dentistry. The faculty numbers 262.

Dr. Capen will be installed as chancellor on Saturday, October 28. Between fifty and seventy-five of the best known leaders in education in the United States and Canada will attend as delegates from the colleges and universities with which they are connected. Speakers at the inaugural will include President Albott Lawrence Lowell, of Harvard; President Livingston Farrand of Cornell; President John A. Cousens, of Tufts; Sir Richard Falconer, of the University of Toronto; Dr. Frank P. Graves, New York state commissioner of education, and Governor Nathan L. Miller, of New York.

Following the installation of Dr. Capen and luncheons for men and women delegates at the University and Twentieth Century Clubs, respectively, there will be a flag-raising at Rotary Athletic Field just before the Buffalo-Clarkson foot-ball game. Rotary Field was made possible by contributions of Rotary Club members over and above what they otherwise contributed to the endowment fund. This field will be part of the campus. The inaugural dinner will be held in the evening.

On Friday afternoon, October 27, exercises will be held for dedication of Foster Hall, the new chemical laboratory of the University of Buffalo. Following an academic procession, the dedication will take place. Funds for erection of the building, which cost upwards of half a million dollars, were contributed during the endowment fund campaign by O. E. Foster, a Buffalo philanthropist.

The laboratory is the first of the buildings to be erected on the new 150-acre site to which, ultimately, all the university departments and activities will be transferred. It is located at the northern end of the city, amid beautiful surroundings, and is an ideal location for development of the greater University of Buffalo.

The expansion program of the University of Buffalo comes as an incident in its long record of usefulness, which started when Millard Fillmore, thirteenth president of the United States, was its first chancellor seventy-five years ago.

Dr. Capen, the son of a former president of Tufts College, commenced his career as instructor, assistant professor and then full professor in modern languages in Clark College, Worcester. Next he was professor of German and lecturer on educational administration in Clark University. He was a member of the Worcester school board from 1908 to 1914 and specialist in higher education in the U. S. Bureau of Education from 1914 to 1919, when he accepted directorship of the American Council on Education.

THE PRESIDENCY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. Samuel Wesley Stratton, for twenty-one years director of the Bureau of Standards at Washington, was elected president of the Massachusetts Institute of Technology on October 11. He will assume the position on January 1.

The institute has been without an executive head since the death of Dr. Richard C. MacLaurin in January, 1920. Dr. Ernest Fox Nichols was elected president in 1921, but was forced by ill health to resign a few months later without having served in office. A committee of faculty and corporation members has carried on the administrative work.

Dr. Stratton was born in Litchfield, Ill., in 1861, and was graduated in 1884 from the University of Illinois, where he later became professor of physics and electrical engineering. From 1892 to 1901 he was professor of physics in the Unversity of Chicago.

As head of the Bureau of Standards he has built up from a small office of weights and measures employing three or four persons a bureau which occupies a dozen buildings and has a staff of more than 900 employees. The bureau is closely aligned with the industries of the country, aiding them in research work and development of methods of precision.

Dr. Stratton has received the honorary degree of doctor of engineering from the University of Illinois and that of doctor of science from the Western University of Pennsylvania, the University of Cambridge and from Yale

University. He was made a Chevalier of the Legion of Honor in 1909.

The New York *Times* reports that Secretary Hoover, commenting on the resignation of Dr. Stratton, said:

The loss of Dr. Stratton as head of the Bureau of Standards is a real national loss. He has built up that service from a bureau devoted to scientific determination of weights and measurements to a great physical laboratory cooperating with American industry and commerce in the solution of many problems of enormous value in industry which the commercial laboratories of the country, from lack of equipment and personnel, have been unable to undertake.

While the Massachusetts Institute of Technology is to be congratulated on securing Dr. Stratton, one can not overlook the fact that the desperately poor pay which our government gives to great experts makes it impossible for us to retain men capable of performing the great responsibilities which are placed upon them.

The Massachusetts Institute of Technology, an educational institution, finds no difficulty in paying a man of Dr. Stratton's calibre three times the salary the government is able to pay him.

Dr. Stratton has repeatedly refused large offers before, but the inability of the scientific men in the government to properly support themselves and their families under the living conditions in Washington, and to make any provision for old age, makes it impossible for any responsible department head to secure such men for public service at government salaries.

SCIENTIFIC NOTES AND NEWS

On October 5 the new biological building of McGill University, erected at a cost of over $500,000, was formally opened. The exercises were presided over by the principal, Sir Arthur Currie. Sir Charles Sherrington, P.R.S., Waynfleet professor of physiology at Oxford University, gave the opening address. He was followed by Dr. Harvey Cushing, of Harvard University. Lectures were also given by Dr. H. J. Hamburger, professor of physiology, University of Groningen, Netherlands, who spoke on "A new form of correlation between organs," and by Dr. John M. Coulter, professor of botany of the University of Chicago, whose subject was "The botanical perspective."

The Faraday Medal of the British Institution of Electrical Engineers, the first award of which was made by the council in the early part of the year to Mr. Oliver Heaviside, was personally presented to him by Mr. J. S. Highfield, president of the institution, at Torquay, on September 9.

The University of Leeds has conferred the honorary degree of doctor of science on Sir Charles Scott Sherrington, the Duc de Broglie, Paris; Dr. C. G. Joh. Petersen, director of the Danish Biological Station, Copenhagen, and Professor P. Weiss, director of the Physical Laboratory, University of Strasbourg.

Mr. Gano Dunn, president of the J. G. White Engineering Corporation of New York City, and second vice-chairman of the National Research Council, has been appointed a delegate from the Research Council to the Pan-Pacific Commercial Conference meeting in Honolulu from October 25 to November 7.

Dr. Martin H. Fischer, professor of physiology in the University of Cincinnati, has been elected a foreign member of the Leopoldinisch Carolinische Akademie of Halle, in the Division of Scientific Medicine.

Dr. Oliver Bowles, of the United States Bureau of Mines, has been admitted as an honorary member of the Institution of Quarry Managers of Great Britain.

At a recent meeting of the Committee on Science and the Arts of the Franklin Institute, an award of the Howard N. Potts Medal was granted to Dr. Charles Raymond Downs and Mr. John Morris Weiss of New York "in consideration of their notable achievement in the scientific and commercial development of the catalytic vapor-phase oxidation of benzene to maleic acid and their pioneer work in developing a commercial process for changing aromatic to aliphatic compounds."

Professor Hüppe, who was for many years director of the Hygienic Institute in Prague, celebrated, on Aug. 24, his seventieth birthday.

A Meyricke Scholarship at Jesus College, Oxford, open to graduates of the University of Wales and of St. Davids College, Lampeter, has been awarded to Leon Rubinstein, of Uni-

versity College, Aberystwyth, with a view to research in chemistry.

Dr. J. A. Detlefsen, who has leave of absence from the Unversity of Illinois, will spend the coming year at the Wistar Institute of Anatomy and Biology, Philadelphia.

Dr. Joseph Swain, former president of Swarthmore College and of Indiana University, previously professor of mathematics and a contributor to biological science, and Mrs. Swain, are spending a year in Japan and China.

Dr. Edmund Otis Hovey spent six weeks during the past summer in making a western tour partly in behalf of the American Museum of Natural History. His special object was to secure photographic and other data in the Pike's Peak region, the region of San Francisco Bay, and at Crater Lake, for use in the construction of relief models at the museum.

Dr. R. C. Farmer has accepted the position of deputy director of explosives research at the British War Office Research Department.

We learn from *Nature* that a committee has been appointed by the British secretary for mines to undertake research, under the general direction of the safety in mines research board, into the causes of, and the means of preventing, the ignition of firedamp and coal dust by the firing of explosives. The committee has been constituted as follows: Sir F. L. Nathan, Mr. W. Rintoul, Dr. G. Rotter, Mr. H. Walker, and Professor R. V. Wheeler. A grant has been made by the miners' welfare committee out of the miners' welfare fund to meet the cost of initiating the research.

The Harvard College Observatory is being opened from 7:30 P.M. to 9 P.M. on the following dates: October 13, October 28, November 13, November 28, December 12. A short illustrated talk will be preceded, when the weather permits, by telescopic observations of celestial objects. Exhibits showing the work of the observatory will be explained by members of the staff. A limited number of tickets of admission for any one of the open nights is supplied on application but must be obtained in advance. There is no charge for admission. The titles include: "Astronomical tests of the relativity theory," "The Harvard Observatory Station in Peru," "The large observatories of the west," "Scientific work for the amateur astronomer."

Dr. Walter B. Cannon, professor of physiology in the Harvard Medical School, gave an address before the Richmond Academy of Medicine and Surgery, September 26.

Dr. Rudolph Matas, head of the department of surgery at Tulane University, New Orleans, recently sailed for France where he attended the annual congress of French surgeons on October 2 and addressed the congress on "The surgery of blood vessels."

The New York Academy of Medicine has organized a celebration of the one hundredth anniversary of the birth of Louis Pasteur, which is to consist of a public exhibition, in the building of the academy, commencing on December 27, the anniversary date, and culminating at the end of a fortnight in an evening of public addresses by distinguished members of the medical profession. The exhibition will consist of a collection of Pasteur memorabilia, such as books, manuscripts, photographs, engravings, medals, etc., illustrating the life work of Pasteur.

F. T. Trouton, F.R.S., emeritus professor of physics in the University of London, died on September 21, at the age of fifty-eight years.

The death is announced of Mr. Louis Heathcote Walter, who had been editor of *Science Abstracts* since 1903.

Dr. J. K. A. Wertheim Salomonson, professor of neurology and radiology at Amsterdam University, died on September 16 at the age of fifty-eight years.

The spring meeting of the American Chemical Society will be held at New Haven, Conn., from April 3 to 7, 1923, inclusive.

The General Hospital Society of Connecticut is residuary legatee of the estate, believed to be considerably in excess of $1,000,000, of Mrs. Sarah L. Winchester, after certain bequests and life estates are taken from it. Mr. Winchester established a tuberculosis annex to a hospital at New Haven, where the Winchester

Arms Company's plant is located, and it was to continue that work that funds were bequeathed to the General Hospital Society.

The annual meeting of the American Society of Ichthyologists and Herpetologists will be held in the Field Museum, Chicago, on Friday, October 27, immediately following the meeting of the American Ornithologists' Union. All persons interested in any line of investigation relating to fishes, amphibians or reptiles are cordially invited to be present and take part in the meeting. Those desiring to present papers should communicate with the committee on arrangements, Karl P. Schmidt or Alfred C. Weed, Field Museum of Natural History, Chicago.

According to the September issue of the *Decimal Educator*, the official organ of the Decimal Association, as abstracted in *Nature*, the metric system has been or is soon to be adopted in Greece, Poland, Haiti and Japan, while the Russian government is rapidly introducing it into its administrative departments. The British Chamber of Commerce in the Argentine and the consul for Bolivia again warn British exporters of the futility of quoting in pounds, shillings and pence for amounts specified in imperial weights and measures. Mr. W. A. Appleton, secretary of the General Federation of Trade Unions, states that "these weights and measures of ours cheat the home buyer and arouse the suspicion of the foreigner," and asks how many buyers know the difference in weight of a peck of potatoes and a peck of peas. The Lancashire cotton market has ceased to quote cotton in sixty-fourths of a penny and now gives the price in hundredths, but we still appear likely to fulfil the prediction of Augustus de Morgan and "adopt the metric system when every other country has done so." Sir Richard Gregory, president of the association, recommends in an introductory article that the metric system should be made the sole legal system in all departments of state, and the nation thus prepared for its general introduction, which is bound to come in its time, as it is foolish to expect the world to adopt the imperial as an international system.

UNIVERSITY AND EDUCATIONAL NOTES

A trust agreement made by Mrs. Lydia C. Chamberlain, formerly of Des Moines, Iowa, who lived for many years in New York City, giving $419,000 to Columbia University for fellowships, has been upheld in the Supreme Court, but an attempt by Mrs. Chamberlain in her will to distribute the rest of her estate to Columbia also under the trust agreement, has been set aside. Mrs. Chamberlain directs that the income from the gift be used to establish "graduate" and "traveling" fellowships, to be restricted to men or women who were born in Iowa, graduated from Iowa institutions, and who return to live in Iowa. The amount payable yearly is limited to $850.

A campaign is being conducted to raise $10,000,000 for the University of Southern California, Los Angeles. Plans provide for a medical school and teaching hospital which will cost, on completion, approximately $3,500,000.

The Prudential Insurance Company of America has made a presentation of its entire sections on geological and geographical science to the library of Wellesley College. The collection includes over 3,000 volumes, publications and maps.

Dr. Elmer Pike has been appointed medical director of the University of Vermont, to succeed Dr. David Marvin.

Dr. Arthur Holmes, recently president of Drake University, has been elected professor of psychology in the University of Pennsylvania, where he will have charge of the welfare of men students.

Mr. Albert J. Walcott, a graduate of the University of Michigan, and for the last three years carrying on research work in optical glass with the Bausch & Lomb Optical Company, has been appointed lecturer in mineralogy at Northwestern University.

Raymond M. Deming, formerly instructor in mathematics at the Case School of Applied Science, has been appointed professor and head of the mathematics department at Upper Iowa University, Fayette.

Professor Robert Morris Ogden, of Cornell University, has been appointed lecturer on education at Harvard University for the second half of the academic year 1922-23.

Dr. Uhlenhuth, director of the Behring Institute for Experimental Therapy in Marburg, has received a call to the chair of hygiene in Bonn, as the successor of Professor Neumann, who has accepted the position left vacant in Hamburg by the death of Professor Dunbar.

DISCUSSION AND CORRESPONDENCE

THE PRODUCTION OF SPECIES

To the Editor of Science: It is often remarked by biologists who have never studied organisms in the field, that it is easy "to develop forms at will indistinguishable from actual species."

To my mind, this is one of the most deceptive of the anti-Darwinian heresies. A species is not merely a form or group of individuals distinguished from other groups by definable features. A complete definition involves longevity. A species is a kind of animal or plant which has run the gauntlet of the ages and *persisted*. Spreading across or around barriers, a species may break up into parallel or geminate species, each having run a special gauntlet of its own, its primitive qualities altering through selection, usually slowly, in the progress of the centuries. A new form inaugurated through change of surroundings, through persistent selection and segregation, or through hybridization, is not a "species" until it can hold its own with the rest. None of the created "new species" of plant or animal I know of would last five years in the open, nor is there the slightest evidence that any new species of field or forest or ocean ever originated from mutation, discontinuous variation or hybridization.

Garden or greenhouse products are immensely interesting and instructive, but they throw little light on the origin of species. To call them species is like calling dress-parade cadets "soldiers." I have heard this definition of a soldier—"one that has stood." It is easy to trick out a group of boys to look like soldiers, but you can not define them as such until they have "stood." A greenhouse variant is easily secured; with some plants excessive variability is itself a specific character. But temporary variations have no taxonomic value. A form is not a species until it has "stood."

The production of species from ancestral forms is a process which has striking analogies to the formation of words from older roots. It is easy to make a new word, as a variant or mutation from an older root, or even to create one without a root. But these creations are not words. They do not get into the dictionaries until they have "stood." They must have held their own in the gauntlet of speech which every word has to run. The new words may look as good as old ones. Riley's "gems that laugh hysteric lights, the glittering quespar, guenk and pleocynth," sound technical enough, but these are freaks of the poet, not real words. Being artificial and unreal they are not actual words, never having "stood" in the linguistic struggle for existence.

David Starr Jordan

THE TEACHING OF EVOLUTION

Readers of Professor Pickett's article on "The Teaching of Evolution"[1] will agree that "the teaching of science, particularly of biology or related subjects, in the high school is the chief area of stress." The teaching of introductory biology demands great tact, and, of course, not all teachers have tact. However, the responsibility for the conflict between religious teaching and scientific teaching can not be placed on those teachers.

Opposition to the doctrine of evolution by Mr. Bryan and those of similar views is not opposition to what Professor Pickett calls theories of evolution. It is opposition to the doctrine of evolution in any form whatever. The dispute between Neo-Darwinian and Neo-Lamarkian does not interest them except as cause for encouragement. To them Darwinism means evolution, nothing more. With an unbending mind they recognize disagreement between the plain literal biblical account of creation and the doctrine of evolution. They embrace the former and are unable to accept any of the compromises that have been offered.

[1] Science, September 15, 1922, LVI, 298.

The biologist is ready to receive new evidence but it is difficult to see how he can trim known facts to suit the opposition. However, science holds the key to the situation. The key is evolution itself, the evolutionary interpretation of history, especially the religious and literary history of the Hebrew people. This rather than biology would quickly become the storm center if it were taught in our high schools. It can not be done at present, but when historical science percolates more thoroughly into the Sunday schools the opposition to the teaching of evolution will dissolve. In the mean time the biologist bears the brunt of opposition because his pupils (or their parents) are not prepared for his message. He has to offer a new interpretation of life, a new basis of ethics, which is in opposition to tradition. He is usually better fitted to discuss and to appreciate the beliefs of the non-scientifically trained man than is the latter to discuss the scientific view, because the biologist has not always been a scientist. The scientist is a trained seeker for truth. His past beliefs, experiences and mental conflicts form a valuable intellectual background. The non-scientifically trained person can not claim a similar appreciation of the scientific view. The biologist must have something of the spirit of a missionary and if necessary that of a martyr.

J. HOWARD BROWN

PRINCETON

TINGITIDAE OR TINGIDAE

IN his discussion of this family name in a recent number of SCIENCE, Dr. W. J. Holland has provided us with an excellent review of the philological and nomenclatural facts in the matter, but he fails to mention certain items which have a bearing on the question.

Some years ago in a review of Van Duzee's "Check List of the Hemiptera" (*Psyche*, XXIII: 129, 1916), I stated very briefly my reason for adopting the form *Tingidæ* and it seems necessary to bring forward this argument again to the end that nothing pertinent be overlooked in reaching our decision. In connection with his original proposal of the generic name *Tingis*, Fabricius ("Systema Rhyngotorum," 1803, p. 124) *himself* uses the genitive *Tingis* in a foot-note, and accordingly we must adopt the family form *Tingidæ*, unless we can prove that the author was in error regarding the genitive form of his own generic name. When I first considered the question I took into account the facts which Dr. Holland adduces, and I came to the conclusion that we can not be sure that Fabricius did in fact adopt the Greek word Τίγγις, the name of a city; on the contrary, his use of the genitive *Tingis* shows us that he considered the word his own and indicates what its Latin declension should be.

Until this argument is disposed of I shall consider it necessary to use the form *Tingidæ*, as proposed by Westwood in 1840.

H. M. PARSHLEY

SMITH COLLEGE

THE VACUUM TUBE AMPLIFIER IN SCIENTIFIC WORK

THE amplification of sound by means of the triode vacuum tube has now passed on from its application to wired and wireless telephony to a means of aiding those of deficient hearing. Its effectiveness is so great that it promises to be to the partially deaf as great a boon as glasses to those optically defective. The use of the amplifier is sure to expand rapidly in this field, although it will be somewhat impeded by its expense.

The purpose of this note, however, is to call attention to the application or applicability of a sound magnifier in various fields of scientific work and industry:

1. For detecting distant underground operations as in mine rescue or military work.
2. Detecting the approach of a boat, train or automobile before it comes in sight.
3. Detecting the approach of a storm.
4. As a parallel instrument to the binocular prism glasses of the ornithologist, to detect bird songs too far to be heard distinctly or at all. It is particularly useful in detecting the higher notes that do not carry far and in observing nocturnal migration.
5. To aid the hunter in detecting sounds of distant game.
6. In conversation from vessel to vessel or station to station at shouting distance and a little further.

7. In directing men aboard or on shore.

8. To extend the possibilities of the dictograph in detecting evidence of crime.

9. To make possible addressing larger audiences and distant audiences.

10. To make it possible for some women with weak voices to nevertheless speak to large audiences.

11. In acoustical research for the study of subliminal sounds.

12. The detecting of subliminal sounds from animals not now known to make sounds.

13. To make more audible the whispers or weak sounds of the sick or injured.

14. To make communication by weak or injured less fatiguing.

That commercial equipment of good efficiency is now readily available may not be known to some of those who might make good use of the apparatus.

Roswell H. Johnson

Pittsburgh, Pa.,
September 22, 1922

CHEMICAL SPELLING

Hurrah for Professor Jacobson and his "chemical spelling match" at the West Virginia University, as described in Science for September 29! Twenty odd years' experience, when permanent secretary of the American Association for the Advancement of Science, in reading the proofs of the program of the chemical section, gave me some definite opinions of chemical terms. I was delighted, in reading the preface to a book recently published by the veteran naturalist, Auguste Forel, to note the expression *la vraie science est l'ennemie des grands mots*. Is it a plain inference from Forel's dictum that chemistry is not a true science?

L. O. Howard

QUOTATIONS

BIOLOGICAL STAINS

The stains employed by a worker in a series of investigations, and other workers repeating his methods, should involve identical materials. It is not necessary that the chemicals should be "pure"; indeed, the results from a particular method have sometimes been due to an unknown impurity, so recalling the famous salt in Stevenson's "Dr. Jekyll and Mr. Hyde." But they must be the same, if identifications are to be made by their use.

It was for these reasons and not from any superiority in German manufacture that authorities in microscopical technic so long ago advised the use of German stains and particularly those of Grübler of Leipzig. The advice was generally adopted, so that a practical monopoly of this small but important and profitable commerce in articles essential to medical practice and scientific research fell into German hands, to universal satisfaction. But the reason for the monopoly and the history of its institution were forgotten. When the war deprived allied countries and the United States of German imports of these chemicals, of which only very small stocks were held, manufacturers in other countries went into the trade. But their products were irregular in their action, did not always produce the familiar results and varied from maker to maker.

The supposed German scientific supremacy obtained another advertisement. It was demanded that importation of scientific stains should be allowed, or, alternatively, that by some great transformation, British, French and American skill should be brought up to the German level. Last autumn the National Research Council of America organized a practical inquiry into stains produced in America, obtaining the cooperation of workers in various branches of biological science. Their preliminary report has now been issued. Briefly, it dispels the idea of German superiority. American stains are often purer than the Grübler products; there is no difficulty in producing what is required. But the trouble is standardization; the stains of different manufacturers produce different effects.

It is suggested in the interests of science that the Research Council, after further inquiry, should determine a standard type for each stain, possibly recommending different manufacturers for different stains. But it is of importance that the standardization should extend beyond one country, so that the results of scientific investigation and the methods of bacteriological identification should be available for different countres. The whole business is small from the financial point of view, and it is to be hoped that standards will be adopted

by international cooperation.—The London *Times*.

SCIENTIFIC BOOKS

Readings in Evolution, Genetics and Eugenics. By HORATIO HACKETT NEWMAN. Chicago, 1921: The University of Chicago Press. Pp. XVIII plus 523.

Doubtless every college teacher who gives a general course in organic evolution has at times wished for the presentation in a single textbook of the materials he has found it necessary to have his students glean from numerous volumes. This need has been met by Professor Newman in the present book. The work is drawn up on much the lines of the "source books" in history which have become popular in recent years, and it will doubtless fulfill a similarly useful function for courses in evolution, genetics and eugenics. The wide range of matter necessary for such courses has been selected from the books and papers of many authors and reprinted in their own words, but the whole has been deftly knit together by means of occasional brief comments and passages written by the compiler himself.

One's preconception of such a presentation is that it must inevitably be a patchwork, but, as a matter of fact, Professor Newman, by judicious selection, has achieved a surprising unity. Another inherent difficulty in such a collection of articles and excerpts is the impossibility of touching out in otherwise excellent older accounts what, in the light of our more recent knowledge, are minor mistatements or contradictions; but here again, through careful choice, the defect has been reduced to a minimum.

The typographical errors observed by the reviewer are few. In line 6, page 294, *this is* should read *that is;* the numeral in line 16, page 365, should be 18 instead of 19; figures 87 and 88 on pages 434 and 435 have been exchanged.

The thirty-seven chapters (512 pages) are divided into five main parts: (1) Introductory and Historical (pp. 3 to 53); (2) Evidences of Organic Evolution (pp. 57 to 182); (3) The Causal Factors of Organic Evolution (pp. 185 to 283); (4) Genetics (pp. 287 to 456); and (5) Eugenics (pp. 459 to 512). Since the historical survey in Chapter II plunges one into the midst of genes, x-chromosomes, selection, orthogenesis, heterogenesis, Mendelism, biometry, etc., the general reader could find his way through this maze far more readily if a full glossary of scientific terms were appended. Such a glossary would also be very helpful in relation to other parts of the work.

In many colleges and universities the work in genetics and in organic evolution is given as separate courses. The reviewer, in fact, has used the volume under discussion in a practical way only as a text for a course in evolution. For such a purpose it would be advantageous to have the sections dealing with variation introduced before or along with the discussion of the causal factors of organic evolution. It is probable also that many teachers would, as does the reviewer, prefer to have the evidences from morphology presented before those from paleontology, but there is, of course, no reason why the user of the book may not take the various sections in this order if he so chooses. While to the initiated the chapters on Neo-Mendelian Heredity, Sex-linked and Other Kinds of Linked Inheritance, and Linkage and Crossing-Over are clear, succinct accounts, it is questionable if the beginner would get far with them without considerable additional elucidation on the part of the teacher.

In the opinion of the reviewer, Professor Newman has, in this series of readings, prepared for the general student the most complete and acceptable one-volume account of organic evolution and allied subjects in print.

M. F. GUYER

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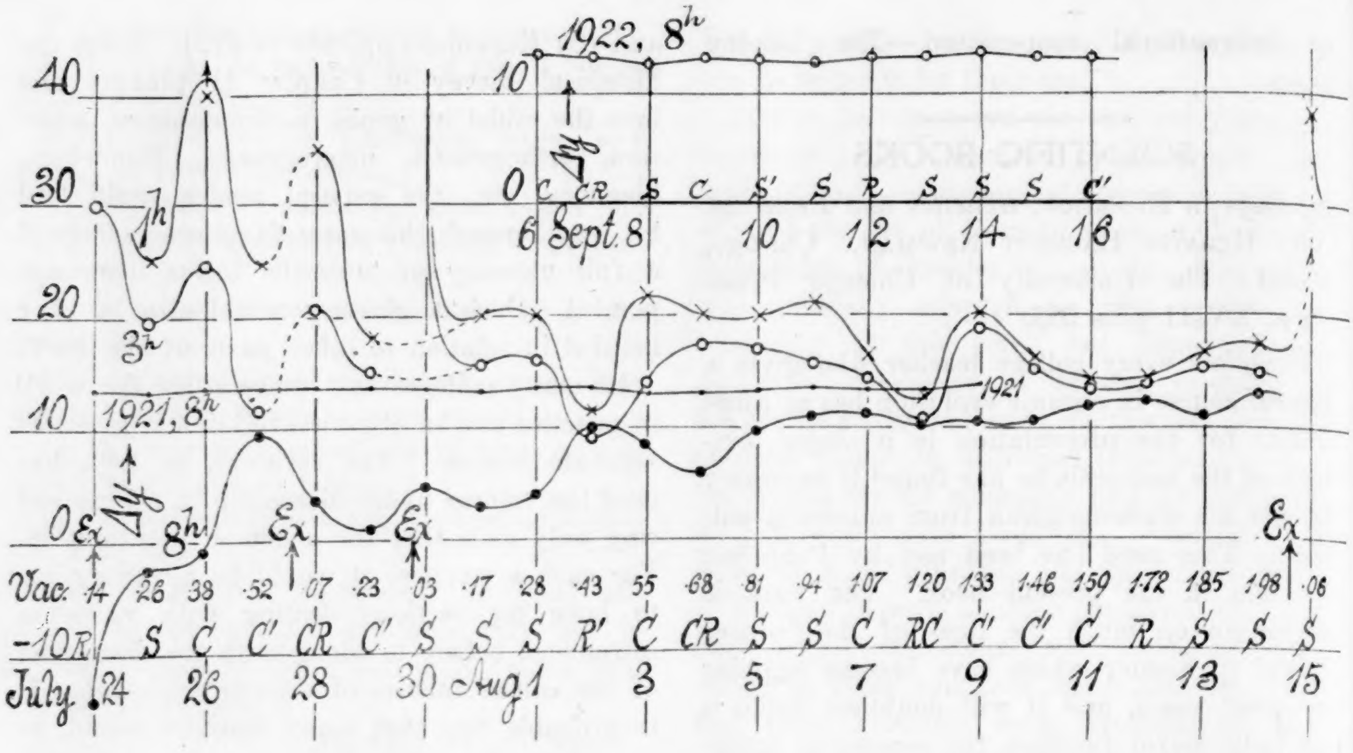
SPECIAL ARTICLES

STATIC DEFLECTIONS OF THE VACUUM GRAVITATION NEEDLE, IN 1921 AND 1922

To obtain a comparison, it will be necessary to measure the distance apart, Δy (y being the telescopic scale reading, with the needle at rest), of the equilibrium curves corresponding to the two opposed positions of the attracting

[1] Advance note, from a Report to the Carnegie Institution of Washington, D. C.



weights, M, at the same hour, on successive days. As the graphs are often quite divergent, the interpolations will lose in accuracy; but the general relations of the results will nevertheless appear much more clearly. These static deflections, Δy, are given in the lapse of time in the figure. For 1922 the graphs are drawn for 1^h, 3^h, 8^h P.M. of the successive days,[2] and are distinguished by circles or crosses. For 1921 the night observations (at about 8 P.M. on the average) only are given, as the other lines would lie too close and confuse the diagram. In fact the variations in 1921 are of a smaller order and must be given on a scale ten times larger to be adequately shown.

The diagram brings out the striking difference of the results very well. For 1921 the observations lie practically on a straight line, $\Delta y = 13.42$, for which the normal period of the needle in vacuo would be 752 sec. In the results for 1922 the time of the successive exhaustions (Ex) is indicated approximately. It will be seen that the cooling or other influence of such an exhaustion (though carried from 1 mm. to .001 mm. only) is still effective in exaggerating the radiant forces, for at least six hours or more (*cf.* July 24, 30) after the exhaustion has been completed. Consequently the graphs for 1^h and 3^h should probably be joined by the dotted lines as indicated.

In all cases the extraneous radiant disturbance which is strong in July, 1922, gradually recedes more and more, as the observations enter the days in August. On July 24 at 8 P.M. the combined gravitation and radiant effect of the attracting mass M was repulsive (Δy negative), the radiant repulsion being about twice the gravitational pull. Positive values are not reached until after July 26. From July 28 on, the 8 P.M. increase is determined, though it has not quite reached the values of Δy even at the end of the diagram (August 14). In the afternoon observations (1922) the rain effect (or the absence of sun effect) is brought out very clearly by the marked depressions on August 2, 8, 11, 12. At night this effect may be reversed. When the day's radiation is scantily received, the needle fails to radiate at night.

In case of the observations of 1921, the small fluctuations of the Δy curves throughout a month showed instances of resemblance to the run of atmospheric temperature. But in the large variations recorded in 1922 (as a consequence perhaps) I was unable to detect such resemblances in the night observations, which are here alone of interest. The same is true of the change of temperature per day, etc. Nevertheless it is possible that relatively

[2] S denotes sunshine, C cloudy, C′ partly cloudy, R rain. Vac. shows the vacuum in mm. of mercury.

short atmospheric temperature changes from without, such as would not be otherwise recorded, may make an impression on the 8 P.M. graph. This, however, would not bear upon the 1922 graph as a whole, from July 24 to August 14. Supposing, moreover, that the closed region within is in some way modified thermally by the high exhaustions (carried to within .001 mm.), it seems hardly probable that the apparatus would take so long to return to the normal condition of 1921.

What has gone down during this series of measuremeents is the vacuum and one would therefore conclude that states of high exhaustion (a few hundredths or tenths of a mm.) are (like the plenum) more susceptible to the presence of radiant activity than the lower exhaustions of a few mm. Thus, night observations presupposed, the radiant forces pass through a minimum in a partial vacuum of several millimeters or more, and the best conditions for observation are then at hand. To test this further, I exhausted the apparatus on August 14. The morning observations August 15, twelve hours later (see figure) are again abnormally high.

It not infrequently happens that night values are low when day values are high and, in general, there is a tendency of the graphs to converge toward rainy or densely cloudy weather. All this conforms with the view that the needle is screened from radiation by the large attracting mass M and that the radiant forces act with gravitation, if the temperature-time coefficient $d\theta/dt$ is positive, and act against gravitation when $d\theta/dt$ is negative, as elsewhere explained. I have been tempted to envisage a coefficient $d\theta/dt$, which is not all temperature; for there may be some other radiation or agency behind the recent rains (for instance), as well as behind the difference in the character of the results of 1922 and 1921 as exhibited by the figure. It is difficult, in other words, to surmise what the nature of the radiant discrepancy may be, which clings to the apparatus so persistently in July and early August. If it were merely thermal, or dependent on a kinetic mechanism associated with $d\theta/dt$, its behavior would seem to be incompatible with the daily cycle, which is practically immediate. However, if the slopes of the curves giving the static elongations, y, of the needle in the lapse of time, are enhanced by the higher degrees of exhaustion, these curves would also ultimately intersect, so that even negative values of Δy, referable to causes within the apparatus would not be unexpected.

On my return to the laboratory in September, I resumed the work (upper curve). The vacuum had in the mean time decreased to about 3 mm. Under these conditions the night observations (8^h) are again normal and compare favorably with the corresponding graph of 1921, as was anticipated.

CARL BARUS

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THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF DYE CHEMISTRY
William J. Hale, *chairman*
R. Norris Shreve, *secretary*

SYMPOSIUM ON METHODS FOR STANDARDIZING AND TESTING DYES

R. E. Rose, *chairman*

Introductory remarks: ROBERT E. ROSE.

Chemical control of dyestuffs: WALTER M. SCOTT. This paper presents a general discussion of various methods for estimating the strength of dyestuffs as follows: (1) Colorimetric comparison of standard dyestuff solutions. (2) Titration of a solution of known strength of dyestuff with a standard solution of titanous chloride in an atmosphere of carbon dioxide. (3 Determination of the percentage of nitrogen by the Kjeldahl method. (4) Estimation of the inorganic salts which have been used in the standardization of the dyestuff. In connection with the materials used in dyeing there is such a great variety that it is only possible to discuss a few of the more common types. This paper gives an outline of the general methods of analysis used and also suggested specifications for the following: acetic acid, sulfuric acid, ammonia, black iron liquor, commercial "nitrate" of iron, di-sodium phosphate, Glauber's salt, common salt and soap made from olive or red oil.

The estimation of erythrosine: W. C. HOLMES. A method is outlined for the direct evaluation of

dye in sample of erythrosine, based upon the gravimetric determination of the color acid, which is shown to have relatively excellent accuracy. The results obtained confirm the conclusion of Gomberg and Tabern that the dried dye contains a molecule of water of concentration. In the absence of interfering substances the consumption of acid involved in the precipitation of the color acid is determined by the dye and soda ash present and may be utilized as a convenient means of estimating the latter. A further investigation is being undertaken to determine the applicability of the methods to other dyes of the Eosine group and to afford evidence regarding their constitution.

The dangers of the titanium chloride method for determining the strength of dyes: EDWARD H. GAMBLE and ROBERT E. ROSE. The quantitative method, as described by Knecht for the estimation of the quantity of dyestuff in a sample by means of titanous chloride, is one which is very valuable; however, it must be used with great discretion and a full understanding of the material being tested. The method is sensitive to changes in chemical composition which are not accompanied by corresponding changes in tinctorial value and, therefore, may be extremely misleading.

Laundering of textiles: A. F. SHUPP. (1) Gross volume of business transacted; persons employed by; annual payroll. (2) Development of standard formulas for laundering cotton, linen, wool, silk and artificial silk fibers. (3) Effect of repeated laundering on cotton goods. (4) Discussion of the proper method for the use of low titer and high titer soaps. (5) Samples of textiles that have been improperly laundered. (6) Samples of textiles that have been poorly constructed. (7) American Institute of Laundering.

Dyeing as an art: J. MERRITT MATTHEWS. Dyestuffs and methods of dyeing have long been employed by many nations as a means of art expression, principally for the production of decorative effects on wearing apparel. The early eastern nations, such as the Indian, Chinese and Javanese, were especially prominent in this line of art work, although we also find a somewhat similar development of this form of art among the early Incas of Peru. The early nations, in contradistinction to our own of the present day, nearly always incorporated their art work in the actual utilities of their everyday life, and as their clothes were the nearest thing to them, they employed their art in the decoration of the fabrics used for their wearing apparel. We are more inclined to make our art work distinct in itself and with little or no connection with the things we use and wear. To us an art object is generally something that is set aside or put in a museum or cabinet, or hung on the wall, and must not be desecrated by using it or wearing it.

The tinting of white papers: W. C. HOLMES. For the tinting of newsprint stock and of white papers of the lower grades the basic dyes are exceptionally well adapted. The acid dyes are well qualified to serve the requirements of medium grade paper. In the tinting of white papers of the best quality it is necessary to resort to colors of the pigment type. The ultramarines, indanthrene dyes and the recently developed phosphotungstic lake products are employed, of which classes of colors each affords relative advantages in various essential respects. In the latter field none of the tinting materials available at present can be considered entirely satisfactory and it would appear probable that products of superior general excellence could be developed in other pigment types, of which the dyes derived from the anilids of beta-hydroxy-naphthoic acid are suggested as one of the more promising fields for investigation.

The relative stability of paper colors to bleach: W. C. HOLMES. Eighty representative paper colors are classified in respect to their relative susceptibility to calcium hypochlorite as determined by laboratory dyeing tests in which the essential conditions of beater operation were duplicated. In general the superior stability of pigment colors to photochemical attack finds an analogy in a corresponding stability to bleach, but little or no agreement is found between the relative susceptibility of the soluble dyes to the action of light and of bleach. From the point of view of coloring considerations it is preferable to eliminate residual bleach from the stock by washing rather than by the employment of anti-chlors.

Use of bichromates in wool dyeing (as mordants): WINTHROP C. DURFEE. Bichromates early used as mordants on wool when dyewoods benefited by oxidation were principal dyestuff. Oxidation is not usually beneficial to synthetic mordant dyes: is generally injurious. Synthetic mordant dyes as organic acids require suitable basic mordants. Bichromates furnish chromic acid peculiarly suited for absorption into wool fiber and conversion into basic chromes. Basic chrome should be combined in fiber with weak organic

acid. Tartrates suitable for source of organic acid. Best results in mordanting require careful consideration of combining weights of reduced chrome. Amount of chrome used as mordant should have as near as practical a weight adjusted to combining weight of quantity of dye to be used.

Influence of tin weighting on the dyeing of silk: L. J. Matos.

Quercetin, constitution and uses: Geo. L. Terrasse. A brief synopsis of the constitution of flavone, flavonol and quercetin is given and attention is called to the brilliant synthetic work on these bodies performed by chemists of repute, these researches leaving no doubt about the correctness of the accepted formulas of the substances just mentioned and other bodies similarly constituted. In spite of the technical importance of quercetin and allied dyes the commercial synthetic non-production of them is emphasized. The color of quercetin in relation to its constitution is discussed and the reasons for the adjective dyeing qualities of this dye are considered. The influence of tautomerism, of the alpha hydroxyl and of the hydroxyls in other positions in the molecule are touched upon, as well as the influence of the quinoid formulation on its color. The application of quercetin to the various fibers with several different mordants is recorded and the characteristics of these dyeings are mentioned. The use of this dye on leather is also given and the analogy of the usual commercial forms of the dye to the tannins is indicated. The production of the various lakes of this color is likewise touched upon. It is pointed out that until the necessary original intermediates be produced much cheaper, or that entirely new and cheap syntheses be developed, quercetin must continue to be produced from natural sources.

An outline of the history and chemistry of the important natural dyestuffs: David Wallace and Emil Lesser, Ph.D. This paper covers the history of natural colors as used in ancient times and the impetus given to the industry by the discovery of America with its source of valuable natural dyestuffs, particularly logwood, fustic, hypernic and quercitron bark. Mention is made of the history of the development of the use of these colors. The chemistry of natural dyestuffs presents an interesting and complex study. It received years of study by such men as Chevroul, Erdmann, Graebe, Kostanacki, Herzig and Perkin. Most of their work was done on hæmotoxylin and brezilin, the coloring principles of logwood and hypernic. In this country, the work of Perkin has been thoroughly reviewed and extended in the search of a method for producing additional dyestuffs from natural sources. The sources, chemistry and application of the above mentioned dyestuffs are discussed. A brief mention is made of the present status of the industry.

Color and constitution: M. L. Crossley and P. V. Rosenvelt. A study was made of the effect of isomerism on the color of certain azo dyes. It is shown that there appears to be a definite relation between the reactivity of the naphthol sulfonic acids of beta-naphthol and the color of the dyes produced from them. The effect of the sulfonic acid group on the beta-naphthol ring appears to be greatest when it is in position 3. In this position it acts as a bathychromic group, while in position 7 it acts as a hypsochromic group. The influence of the nitro group on the benzene ring in an ortho position to the diazo group shifts the absorption of the dyes toward red. This effect is manifested to a maximum degree by the nitro group in the ortho position. When the nitro group is in the meta position it acts as a hypsochromic group, shifting the color of the nitrobenzene-azo-beta-naphthol-sulfonic acids in the entire series toward the yellow and beyond that of the corresponding benzene-azo-B-naphthol-sulfonic acid series. The methyl group substituted on the benzene ring has less influence on color than the nitro group. Chlorine appears to have very little influence on the color of the chlorobenzene-azo-B-naphthol-sulfonic acids. Bromine in the ortho position to the diazo group acts as a bathychromic group in dyes resulting from F acid and R salt but has no influence on the color of the dyes resulting from G salt and B-naphthol-3.6.8-trisulfonic acid. The sulfonic acid group introduced on the benzene ring shifts the color of the benzene-azo-B-naphthol-sulfonic acids towards yellow, the maximum effect being manifested by the meta position.

Constitution and chemical reactivity: M. L. Crossley and P. V. Rosenvelt. It is shown that there is some apparent relation between chemical constitution and reactivity in the B-naphthol-disulfonic acid products. The 2-naphthol-3.6-disulfonic acid, R salt, couples readily with azo compounds to give corresponding dyes, while the 2-naphthol-6.8-disulfonic acid and the 2-naphthol-3.6.8-trisulfonic acid, both of which contain a sulfonic acid group in the 8 position, do not react under ordinary conditions for coupling, with certain diazo compounds, particularly those containing a methyl group in an ortho position to the diazo group. Since the hydrogen atom in the adjacent position to the hydroxyl group is the only

one of the several on the naphthol ring replaced by a diazo group, since the naphthol-sulfonic acids having a sulfonic acid group in position 8 do not form nitroso compounds, and since the substitution of an aryl radical for hydrogen of the hydroxyl group diminishes the reactivity of the adjacent hydrogen atom, as is evidenced by the fact that coupling no longer takes place on the naphthol ring, it is suggested that there is a dynamic relationship between the hydroxyl radical and the adjacent hydrogen atom, that this relationship is enhanced by a sulfonic acid group in position 3 and inhibited by a sulfonic acid group in position 8. It is further suggested that this condition of a "loose" hydrogen atom when position 8 is not occupied constitutes a condition of an "open field of reactivity," while the condition of the hydrogen atom when position 8 is occupied constitutes a condition of a "closed field of reactivity." An open field of reactivity is considered necessary for the formation of preliminary addition products, before any can result in the formation of stable reaction products.

Rhythmic bands of dyes on filter paper by evaporation. The refractivity, surface tension, conductivity, viscosity and Brownian movement of dye solutions: Earl C. H. Davies. (Lantern. Illustrated). Striking bands of dyes have been obtained, by a method of evaporation, in filter paper and with unglazed porcelain. There are no marked relations between the formation of these bands and the physical properties of the dye solutions, but it is probable that the viscosity of the very concentrated solutions is important. Oriented adsorption takes place in rhythmic band formation. A study was made of 62 dyes with 3 varieties of filter paper.

Adsorption phenomena in the application of dyes to plain and mordanted fabrics: L. W. Parsons and E. D. Lord. This paper deals with adsorption phenomena which occur in the dyeing of wool and mordanted cotton. The results are treated by the Freudlich adsorption equation, $\frac{x}{m} = kc\frac{1}{n}$, where $\frac{x}{m}$ is the grams of dye adsorbed per gram of adsorbent, c is the concentration of dye in the bath in equilibrium with the dyed fibres, and k and $\frac{1}{n}$ are constants for each individual dye. Characteristic samples of pure dyes containing various chromophore groupings were studied, the data applied to the adsorption equation and the factors affecting the exponent, $\frac{1}{n}$, are discussed. (1) In azo dyes the value of $\frac{1}{n}$ is in general high, and only slightly affected by the addition or removal of OH or So_3Na groups. (2) Thiazene dyes have particularly a low value. (3) Xanthene dyes containing the grouping COON or $COOCH_3$ have a low value for the exponent, the value being raised, however, if this group is absent. (4) The nitro group raised the value of $\frac{1}{n}$ provided that there is not a counteracting factor. (5) Triphenylmethane dyes have, in general, a low value. (6) In the case of mordanted cotton $\frac{1}{n}$ is particularly low, indicating that adsorption is a major factor. (7) This work is still in its infancy, but it is believed that a systematic study of such data and an application of it to the dyeing processes will lead to generalities of interest both to the practical dyer and to the physical chemist.

Dyes of the dinitro-malachite green series: T. B. Downey with Alexander Lowy. 2, 4-dinitrobenzaldehyde was condensed with dimethylaniline, benzyl-ethyl-aniline and diethyl-aniline (in the proportion of 1 mol. to 2 mols.), yielding 2, 4-dinitro-malachite-green dyestuffs which have the characteristic blue-green color typical of the malachite green series. The properties of the leucobases and dyes derived therefrom were studied. Samples of the dyes and dyeings will be shown.

Catalytic oxidation of anthracene to anthraquinone: C. E. Senseman and O. A. Nelson. The importance of anthraquinone as an intermediate in the manufacture of dyes is shown. Mention is made of the old methods of manufacture, chief among which is the chromic acid method. The catalytic method, patented by Gibbs and Conover, and worked out by the authors, is described in detail. The apparatus consists essentially of: (1) a carburetor, (2) reaction chamber and (3) sublimer for collecting the reaction products. All these parts are made of glass and heated by well-insulated electric heaters. The carburetor is built with two air inlets, one arranged so as to sweep over the molten anthracene and thus carry a definite amount of the hydrocarbon into the reaction chamber, the other arranged so as not to interfere with the work of the first but to vary the air-anthracene concentration as desired. Four methods of supporting the catalyst, vanadium pentoxide, are described. They are: (1) by boats, (2) by discs, (3) by

pumice, (4) by fusing to a glass tube. The sublimer, as used during most of the runs, consists of a Kjeldahl flask with neck removed, and joined to the reaction chamber by a ground-glass joint. Tables were compiled showing the influence of different variables in the production of anthraquinone. The maximum yield obtained was 85.3 per cent. of the theoretical.

Equations for vapor pressures and latent heat of vaporization of naphthalene, anthracene, phanenthrene and anthraquinone: O. A. NELSON and C. E. SENSEMAN. This work deals only with the calculated vapor pressures and latent heats of vaporization of naphthalene, anthracene, phenanthrene and anthraquinone, and is an outgrowth of the work published by the authors on the observed vapor pressures of these compounds in *J. Ind. Eng. Chem.*, 14 (1922), 58. The calculations were made by applying the Clapeyron equation of state. A discussion of the derivation of the equation is given. The entropy of vaporization of the same compounds was also calculated and the conclusion arrived at that all form normal liquids. Tables for observed and calculated vapor pressures were given for each compound. In each case the calculated agrees favorably with the observed.

Carbazole, its purification and vapor pressure determination: C. E. SENSEMAN and O. A. NELSON. Carbazole of 82 per cent. purity was washed three times with benzene at a temperature of 50° C. Successive crystallizations from benzene and toluene followed, giving a product melting at 244.8° C. Analysis showed the presence of 8.22 per cent. of nitrogen, while the theoretical per cent. present is 8.38. Using this material vapor pressure determinations were made by the method and apparatus described previously by the authors in *J. Ind. Eng. Chem.*, 14 (1922), 58. Two tables were given. Table I records the pressures and corresponding temperatures. Table II gives the pressures at 5° temperature intervals read from a curve made from the observed readings. The boiling point was found to be 354.76° C. This constant was previously reported in the literature to be 351.5° C. From the Clapeyron equation of state a formula was derived for calculating the vapor pressures at the various temperatures. These calculated pressures closely approximate the observed ones.

The influence of change in concentration on the absorption spectra of dyes: W. C. HOLMES. A brief review of the literature on the subject is given. An outline of the preliminary results obtained by varying the concentration of a large number of dyes over a wide range is presented, together with representative absorption curves illustrating various types of behavior. The interpretation of results and their bearing upon the condition of dyes in solution is discussed.

The synthesis of dicyanine A: S. PALKIN. In the synthesis of dicyanine by the action of sodium ethylate on an alpha, gamma quinoline intermediate it was found that the relative proportion of dicyanine and cyanine produced varied considerably with the *same sample of intermediate*, in different experiments. The possible presence of other intermediates was not thought to be wholly responsible for the formation of contaminating dyes. A study of the influencing factors resulted in the development of an improved process for this dye, which depends upon the action of sodium sulfide and chloroform on an alpha, gamma quinoline intermediate in alcoholic solution. At least two other types of dyes are formed simultaneously by this method, one showing an absorption spectrum maximum at 6200 Å (kryptocyanine). Optimum conditions have been worked out for the preparation of dicyanine A IV (absorption maximum about 6720 Å). The resulting product was found to have sensitizing power equal to Hoechst Dicyanine. The yield of dye by this method is over twelve times that obtainable by any previous method.

The preparation and separation of the ortho- and nara-chloro-anilines: H. C. BASHIOUM and P. O. POWERS. The work was done to find a method capable of technical development for the preparation of the intermediates. Chloro-benzene was nitrated, and the mixture of o- and p-nitro-chloro-benzene was cooled, separating a part of the para isomer. The remaining mixture of nitro compounds was heated to distill off any remaining chloro-benzene and then reduced by boiling with iron and dilute hydrochloric acid. Steam distillation was used to remove the ortho-chloro-aniline which was obtained very nearly pure. Para chlor-o-aniline can be obtained by neutralizing and continuing the distillation with steam. Several other methods of separation were investigated.

The preparation of phenyl-thioglycol-o-carboxylic acid, thioindoxyl-carboxylic acid, thioindoxyl and thioindigo: M. X. SULLIVAN. The brick-red precipitate obtained by running H_2S into diazotized anthranilio acid at 0°-5° C. was treated with chloro-acetic acid in slightly alkaline medium and warmed to 75° C. The filtrate therefrom cooled and acidified with HCl gives phenyl-thio-glycol-o-carboxylic acid. This heated with 5 parts NaOH and a little water gradually to

160° with stirring and kept at 160° for 1 hour gives on dissolving in water and acidifying the cooled solution (in ice) thioindoxyl-carboxylic acid. Warming the acidified solution or heating the solid with acetic anhydride gives thioindoxyl distillable with steam. In alkaline solution thioindoxyl-carboxylic acid and thioindoxyl are converted by potassium ferricyanide to thioindigo, the former on heating the latter directly. The motive for the work is, in the present case, biothenical.

Division of Chemistry of Medicinal Products
Edgar B. Carter, *chairman*
E. H. Volwiler, *secretary*

SYMPOSIUM—DEVELOPMENT OF AMERICAN SYNTHETIC MEDICINALS

The American-made "chloramine" antiseptics: P. N. Leech.

Progress in the manufacture of arsphenamine: G. W. Raiziss.

Present status of the field of local anesthetics: E. H. Volwiler

Recent developments in the chemistry of organic mercurials: Frank C. Whitmore.

New medicinal mercurials: Oliver Kamm.

Chemical and pharmacological studies of benzyl compounds: David I. Macht.

A synthesis of thymol from p. cymene. II: Max Phillips. A process for making synthetic thymol from p. cymene is described. The method consists in first preparing nitrocymene, reducing this to cymidine, sulfonating the cymidine to cymidine-sulfonic acid, diazotizing the cymidine-sulfonic acid to diazo-cymene-sulfonic acid, reducing the latter to cymylhydrazine p. sulfonic acid, removing the hydrazine group cymene-3-sulfonic acid, fusion of the sodium salt of this acid with potassium hydroxide and obtaining thymol. An over-all yield of about 15 per cent. of the theoretical one is obtained.

A method for assaying unguentum stramonii: A. R. Bliss, Jr. The U. S. P. IX gives no method for standardizing unguentum stramonii. Bliss and Brown present a method adapted from the U. S. P. assays of extractum stramonii, extractum belladonnæ foliorum, and fluidextractum belladonnæ radicis, which gives very accurate results as shown by experiment data reported. The method consists of the usual treatment with ether-chloroform mixture and ammonia water; followed by thorough shaking and subsequent standing or by centrifuging; extraction with weak sulfuric acid; subsequent addition of ammonia water with final extraction with chloroform, and titration of the chloroformic residue in the usual fashion.

Some hypnotics of the barbituric acid series: H. A. Shonle and A. Moment. Of the various di-alkyl and alkyl-aryl barbituric acids prepared and tested, isoamyl-ethyl barbituric acid was found to have the greatest hypnotic activity combined with a low toxicity. Isobutyl-ethyl and n-butyl-ethyl barbituric acids were next in activity. Benzyl-ethyl and benzyl-propyl barbituric acids, while possessing hypnotic activity, caused tetanic convulsions. Increasing the length of the chain of both alkyl groups tends to cause muscular incoordination. It appears possible that the optimum activity lies in those members of the series which are more oil soluble and also chemically less stable. The usual method of synthesis was used in the preparation of this group of compounds.

Germicidal assays with special reference to colloidal silver compounds: Herbert C. Hamilton. Tests of germicides other than the coal tar compounds should be carried out under conditions similar to those under which the substance would be used, particularly time of reaction and organism. The values so obtained have more practical significance than the official hygienic laboratory coefficients. Colloids appear to vary in value more greatly than some other disinfectants, making it difficult to obtain a true valuation. Tests were made with some common disinfectants on a variety of organisms including those isolated from a typical case of "pink eye," also *B. pyocyaneous*, diphtheria, pneumonia and others. The substances tested include colloidal silver iodide, colloidal metallic silver, silver nitrate and other well-known disinfectants. Considerable data are included.

The chemistry of digitalis: Herbert C. Hamilton. This is a continuation report on the active agents of digitalis with some additional data on their purification and activity.

Hypnotics of the nirvanol series—phenyl butyl hydantoin: E. H. Volwiler and E. B. Vliet. Nirvanol, or phenyl-ethyl hydantoin, was at first acclaimed as the hypnotic *par excellence*, but in recent years it has been found to occasionally produce severe rash and fever. A number of other substituted hydantoins have already been prepared and investigated, but none of them appeared promising. The various analogous members of the hydantoin series and of the barbituric acid series seem to have no particular relationship from the hypnotic side, for example, the dialkyl hydantoins have practically no hypnotic action. Phenyl n-butyl hydantoin was prepared and found to have no hypnotic action whatsoever.

Chemotherapeutic studies of various aromatic organic arsenicals: GEORGE W. RAIZISS and JOSEPH L. GAVRON. The authors have found that in experimental trypanosomiasis due to infection with *T. equiperdum* complete cures may be effected by employing very pure samples of the two pentavalent organic arsenicals—p-arsanilic acid and 3-amino-4-hydroxyphenylarsonic acid. The chemotherapeutic indices $\frac{\text{maximum tolerated dose}}{\text{minimum curative dose}}$, which are 6.7 and 10, respectively, are of particular interest in view of the favorable results obtained by various French investigators in the treatment of human syphilis with the above arsenicals. Furthermore, by utilizing these compounds as coupling agents the authors have prepared various arsenical dyes and found them to possess but feeble trypanocidal properties. Methods for the preparation of pure p-hydroxyphenylarsine and 3-animo-4-hydroxyphenylarsine have also been developed.

Experimental work in the prediction of physiological action: OLIVER KAMM. Considerations from the standpoint of molecular magnitude are of value in predicting certain toxicity data of mono-hydroxy alcohols. From the physiological results obtained with aliphatic members it was possible to predict corresponding effects of alcohols of the benzyl type, thus showing that benzyl compounds are devoid of certain specific effects sometimes credited to them.

CHARLES L. PARSONS,
Secretary

THE AMERICAN ASTRONOMICAL SOCIETY

THE twenty-eighth meeting of the society was held at the Yerkes Observatory, Williams Bay, Wisconsin, on September 5 to 8, 1922. This was the twenty-fifth anniversary of the opening of the observatory and also of the founding of the society, which grew out of the conference of astronomers held in connection with the dedication of the observatory in 1897. The members and visitors, who numbered about one hundred, were quartered at the Y. M. C. A. Camp on the shore of Lake Geneva.

Sessions for papers extended over three days, and the social events included a reception at the home of Director and Mrs. Frost, a boat ride on Lake Geneva, and the annual dinner. On one evening Professor E. E. Barnard gave an illustrated lecture on "Some Peculiarities of the Comets," and the anniversary celebration included reminiscences of the twenty-five years of the observatory and of the society. A series of astronomical moving pictures was also exhibited.

Nineteen new members were elected to the society, bringing the total membership up to three hundrd and ninety. The society elected to honorary membership Professor H. H. Turner, director of the University Observatory, Oxford, England.

Officers for the ensuing year are as follows:

President: W. W. Campbell.

Vice-presidents: John A. Miller, Henry Norris Russell.

Secretary: Joel Stebbins.

Treasurer: Benjamin Boss.

Councilors: Philip Fox, Caroline E. Furness, A. O. Leuschner, John M. Poor, Charles E. St. John, Frank Schlesinger, Frederick Slocum.

Members of the National Research Council: W. W. Campbell, Edwin B. Frost, Henry Norris Russell.

The next meeting of the society will be held in affiliation with the American Association for the Advancement of Science at Boston and Cambridge in December, 1922.

The program of papers was as follows:

A spectroscopic method of deriving the parallaxes of A-type stars: WALTER S. ADAMS and A. H. JOY.

Partial explanation, by wave-lengths, of the K-term in the B-types: SEBASTIAN ALBRECHT.

Trigonometric parallax of the Pleiades: HAROLD L. ALDEN.

The variable star, M 5, Bailey 33: E. E. BARNARD.

Saturn's rings when the earth passed through their plane in 1920-1921: E. E. BARNARD.

Redetermination of secondary standards of wave-length from the new international iron arc: KEIVIN BURNS, C. C. KIESS and W. F. MEGGERS.

The orbit of the spectroscopic binary H. R. 6532: J. W. CAMPBELL.

Nova Scorpii No. 3 (1922): ANNIE J. CANNON.

Measurements of planetary radiation: W. W. COBLENTZ and C. O. LAMPLAND.

On the light variations of Beta Lyræ and Delta Cephei: R. H. CURTISS.

The parallax of Capella from desentitized plates: ZACCHEUS DANIEL.

A new spectrocomparator: RALPH E. DELURY.

The Steward Observatory of the University of Arizona: A. E. DOUGLASS.

The variable double star X Ophiuchi: C. H. GINGRICH.

Parallax of the nebula surrounding B.D.+31°643: C. H. GINGRICH.

The orbits of the spectroscopic components of Boss 3793 (foll.): W. E. HARPER.

Two long period spectroscopic binaries: W. E. HARPER.

The relation between the stars of the Beta Canis Majoris type and the Cepheid variables: F. HENROTEAU.

Proper motions of stars from micrometric measures: LAURA E. HILL.

A table of x — sin x: HERBERT A. HOWE.

The variable star SX Herculis: M. F. JORDAN.

Wave-lengths in the red and infra-red spectra of oxygen and nitrogen: C. C. KIESS.

Photometry of moon: EDWARD S. KING.

Color-index apparatus: EDWARD S. KING.

Photographic observations of nebulæ: C. O. LAMPLAND.

A new scouting spectroscope for prominences: OLIVER J. LEE.

On the determination of magnitude error by Kapteyn's "spot" method: OLIVER J. LEE.

The distribution of novæ: KNUT LUNDMARK.

Historical note concerning the fundamental equations in stellar statistics: KNUT LUNDMARK.

The proper motions and mean parallax of spiral nebulæ: KNUT LUNDMARK.

The influence of a general cosmic curvature on the Einstein phenomena in the solar system: A. C. LUNN.

Internal motion in the spiral nebulæ: N. G. C. 2403, 4736 and 5055: A. VAN MAANEN.

The quantum theory of photographic exposure: C. E. K. MEES.

The graininess of photographic negatives: C. E. K. MEES.

Some new sensitizing dyes: C. E. K. MEES.

The relation between intensity and exposure: C. E. K. MEES.

Interferometer measurements of the longer waves in the iron arc spectrum: W. F. MEGGERS and C. C. KIESS.

Recent advances in nebulæ: D. H. MENZEL.

Interferometer measures of star diameters: A. A. MICHELSON and F. G. PEASE.

Trigonometric parallaxes of Cepheids and early type stars determined by photography at the Leander McCormick Observatory: S. A. MITCHELL.

On the daily variation in clock corrections: H. R. MORGAN.

Photometric results in certain Kapteyn areas: J. A. PARKHURST.

The total radiation of variable stars observed with the vacuum thermocouple at Mt. Wilson: EDISON PETTIT and SETH B. NICHOLSON.

A pendulum method of recording radio time signals: EDWARD C. PHILLIPS.

The ultra-violet spectrograph of the 72-inch telescope: J. S. PLASKETT.

The spectra of three O-type stars: H. H. PLASKETT.

Some fine occultations coming: WILLIAM F. RIGGE.

Planetary photography: FRANK E. ROSS.

Accuracy of photographic registration: FRANK E. ROSS.

Notes on ionization and pressure in the stars: HENRY NORRIS RUSSELL.

Further observations on wave-lengths in the spectrum of Venus: CHARLES E. ST. JOHN and SETH B. NICHOLSON.

The problem of three bodies and the spectrum of neutral helium: LUDWIK SILBERSTEIN.

A possible new method of stellar photometry: LUDWIK SILBERSTEIN.

Observation of temporary white areas on Mars: E. C. SLIPHER.

The star fields for the 1923 and 1925 total eclipses of the sun: FREDERICK SLOCUM.

On ionization in stars: JOHN Q. STEWART.

On the spectroscopic binary Gamma Ursæ Minoris: OTTO STRUVE.

Chronographic recording of wireless time signals: R. MELDRUM STEWART and J. P. HENDERSON.

Comparison between Paris and Washington time services based on chronographic registration of Bordeaux, Annapolis, and Arlington radio time signals: F. D. URIE.

Observations of Jupiter's faint satellites, and of Phœbe, with the two-foot reflector of the Yerkes Observatory: G. VAN BIESBROECK.

Radial velocity of the Præsepe cluster from objective-prism neodymium plates: H. C. WILSON.

Eclipsing variables showing two spectra: C. C. WYLIE.

Proper motions of some faint stars: EVERETT I. YOWELL.

Uniform clock rates for a period of an entire year: M. L. ZIMMER.

JOEL STEBBINS,
Secretary